

## **Technology and the Labor Market: Past, Present, and Future**

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In his *Six Centuries of Work and Wages: The History of English Labour*, James E. T. Rogers (1884, p. 495) describes the following incident from the early nineteenth century:

Thus in 1811-12, stocking and lace frames had been applied to the staple manufactures of Nottingham, and the discontented labourers, foreseeing or fancying that their livelihood would be imperiled, broke into houses and destroyed the frames. The legislature therefore passed an Act afflicting, as usual, the punishment of death on the frame breakers.

Contained in this brief description is the trinity of factors that are the focus of this essay, namely, labor market outcomes, technological change, and government intervention in the labor market.

The linking of the elements in the trinity just outlined has become more systematic with the passage of time. Among the most significant developments in this regard is the formal incorporation of the technological factor into the economic theory of wage and employment determination that emerged subsequent to 1890. John Bates Clark (1899) and Alfred Marshall (1920) generally are given credit for extending the marginalist revolution initiated by Karl Menger (1871) and William Stanley Jevons (1871) into the realm of the labor market, producing what is generally known as the marginal productivity theory of wages and employment.

In its fully developed early form, the marginal productivity theory argues that the remuneration of both labor and capital would be determined by its contribution, at the margin, to the output of the productive process. This suggests two rather significant

propositions. The first is described rather eloquently by Marshall (1920, p. 544), as follows: "The prosperity of each [capital and labor] is bound up with the strength and activity of the other." As thus interpreted, the marginal productivity theory provides a refutation of the Marxian paradigm of class warfare between workers and the owners of capital goods.

The second significant implication of the marginal productivity analysis lies in the long-term linkage between the rates of remuneration of workers and productivity-enhancing technological progress. If technical progress increases the productivity of workers, it also increases the wage rate earned in the market place. Therefore, far from being a threat to workers, technological progress can be viewed as a factor that makes workers more attractive to employers, leading to greater compensation and employment opportunities for the laboring classes.

These relationships hold at both the micro- and macroeconomic level. What is implied is the operation of the Law of Demand in labor markets, i. e., a negative relationship between the level of real wage rates and the quantity of labor demanded by entrepreneurs. Until very recently, this premise has been relatively unchallenged. However, the introduction into the literature dealing with labor markets of the notion of "efficiency" wages, i.e., that increases in real wage rates induce workers to be more efficient, increasing the productivity of labor, offers something in the way of an alternative to the straightforward marginal productivity notion. Under certain circumstances, this could lead to higher real wages being associated with greater quantities of labor being demanded by employers. Space constraints do not permit a full evaluation of the "efficiency" wage argument here. Suffice it to say that I am skeptical of the validity of the notion. However, for the purposes of this essay, its relevance is limited only to employment matters. On the wage side, whether one accepts the traditional marginal productivity theory of wage determination or the efficiency wage notion, productivity and wages are closely linked to one another in a positive fashion. As to the employment issue, I refer the reader to the book *Out of Work: Unemployment and Government in Twentieth Century America*, which I co-authored with Richard Vedder (1997). In that volume, substantial

evidence is presented confirming the standard marginal productivity theory of employment.

### **Some simple empirical evidence**

The relationship between real wage rates and labor productivity at the macro-level might be challenged on the basis of the empirical evidence of the past quarter century. A commonplace argument in recent years has been that real wages in the United States have declined since the business cycle peak year of 1973. Table B-47 in the 1999 *Economic Report of the President* shows a fall in hourly real wages of over nine percent between 1973 and 1998 and a decline in real weekly earnings of almost 16 percent. At the same time, the average productivity of labor was rising by 35 percent in this interval (see Table B-49 of the *Economic Report*). At first glance, these data would seem to refute the notion of a close relationship between changes in real wages and changes in labor productivity.

The apparent disparity between growth in productivity and real wages is an illusion. A combination of definitional difficulties and price index biases is the source of the discrepancy. The wage data in Table B-47 deal only with money wages, ignoring fringe benefits that are a part of the total compensation package that represents the true cost of labor for employers. Those other elements in the compensation of labor have become relatively more important through time. In addition, the weekly money earnings data are distorted by declines in the average work week and both the hourly and weekly data are deflated by the official Consumer Price Index, which even the government officials in charge of the index admit developed a significant upward bias in the 1970s and early 1980s.

To illustrate the impact of these factors, I have calculated the growth in real hourly compensation of labor since 1973 using the hourly compensation and GDP price deflator data from Table B-49. The result? Almost a 38 percent growth, quite similar to the hourly productivity growth. The time pattern of movement in these data and hourly productivity is shown in Figure 1. That diagram is quite consistent with the idea that productivity growth and real wage growth are intimately connected with one another. This, in turn,

means a linkage between technological progress and the real wage rate due to a combination of what economists call disembodied and embodied technical progress. Whichever occurs, the greater the volume of technical change that augments the output of labor, the greater will be the rate of change in both the average productivity and real wages of labor.

### **The role of government**

With the congruence of movements in productivity and real wages established, it is now possible to turn to the third factor of the trinity previously described, government. The possible impacts here are multiple in character. On the one hand, it can be argued that certain types of government activity can enhance the productivity of an economy. Things such as providing for the common defense, establishing a legal framework for resolving disputes, constructing a basic infrastructure, and supervising some minimum safety net are possibilities in this respect. These are the positive benefits of government and they have the potential to encourage technological progress and increase the productivity of labor. However, they can be negated substantially if government expands inordinately. At some



point, taxation, regulation, and spending may have a negative effect on the productive sector.<sup>1</sup>

In the strictest economic sense, the positive effects of government tend to reduce the costs of producing goods and services, thereby raising output and lowering prices. On the negative side, when government has a deleterious effect on the economy, costs of production are increased, prices rise, and the total volume of output declines. Such effects can be viewed as the deadweight losses to an economy generated by government activities.

What is critical in evaluating the impact of the growth in government on the American economy is the net effect of the positive and negative contributions. When government is small, additions to it are likely to improve society's economic performance, encouraging technological progress and increasing labor productivity. However, as it becomes larger and larger, the gains it provides become attenuated until they disappear entirely. Beyond that point, further increases in the magnitude of government actually may harm the economy. What this implies is the possible existence of a systematic relationship between the size of government and the level of economic activity in a nation, particularly the productivity of labor. At low levels of government activity, its net contributions may be positive but at high levels can become negative.

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<sup>1</sup>This presumes that regulation and spending are complements, not substitutes. A referee for this paper makes the point that if we had effective spending constraints, regulation could be used as a substitute. However, since we do not have such constraints, regulation is likely to be complementary to spending. Consequently, spending as a proportion of GDP should be an adequate measure of the size of government.

Data from the post-World War II era in the United States suggest that such a pattern of impacts may have been occurring. For example, in the interval 1946-1973, federal government spending barely exceeded twenty percent of Gross Domestic Product in only two years. Subsequent to 1973, though, beginning in 1975, spending was greater than or equal to 20 percent of GDP for 23 consecutive years, only falling below that level in 1998. On the productivity and real wage side, both more than doubled between 1948 and 1973, a rate of increase approximately three times greater than that for the years 1973-1998. Therefore, what we see in the post-World War II era is a first half in which federal government spending is relatively low and real wage and productivity growth are robust, followed by a second half marked by greater federal spending and significantly reduced wage and productivity growth—the great wage-productivity growth slowdown.

### **An empirical evaluation of government's impact on productivity**

The availability of numerical data detailing levels of federal government expenditures, expressed as a percent of GDP, and the average productivity of labor allow a statistical evaluation of the suggested relationship between the size of government and the productivity of labor. To do this, a statistical relationship of the following form has been estimated:

$$(1) \text{ PR} = a + bG - cG^2 + dT + e$$

where PR represents the annual average productivity of labor, T delineates the passage of time, G is federal government spending as a percentage of Gross Domestic Product and  $G^2$  is the square of the variable G. The variable T is included to control for the long-term

growth in the average productivity of labor.<sup>2</sup> The statistical results are reported in Table 1. All of the independent variables are statistically

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<sup>2</sup>It might be argued that there should be some control for cyclical variation in productivity as well as trend. Efforts were made to do this by including an unemployment variable in the regression model. However, it was not significant and did not significantly alter the results of the estimation.

Table 1

Regression Results, Analysis of Impact of Federal Government Spending on Average Output Per Hour of Labor Employed, United States, 1947-1994

Independent Variable	Regression Coefficient	t-Statistic
Federal Government Expenditure as Percent of GDP	4.18	4.16
Square of Federal Government Expenditure as Percent of GDP	- 0.12	4.18
Time	1.62	42.81

Note: Other regression statistics: Adjusted  $R^2 = .9942$ ; D-W = 1.47; ARIMA Adjustment = (0,2).

Source: Bureau of Labor Statistics, Department of the Treasury, and author's calculations.

significant at commonly accepted levels. Also, the signs of the variables indicate that the hypothesis that, beyond some size, growth in the magnitude of government adversely affects the productivity of labor is confirmed. Interestingly, the value of  $G$  which growth in government begins to exert its negative effects is a federal government share of Gross Domestic Product of 17.4 percent, below the actual level of spending observed throughout the post-1973 era. It is worth noting that this finding is consistent with the large number of studies during the past two decades that have identified the existence of deadweight losses associated with government activity (Ballard, Shoven, and Whalley, 1995; Barro, 1997; Feldstein, 1995 and 1996; Gallaway and Vedder, 1995; Gwartney, Lawson, and Holcombe, 1998; Marsden, 1986; Rahn and Fox, Jr., 1998; Scully, 1992, 1994, and 1998; and Vedder and Gallaway, 1998a and 1998b).

Of course, the negative impact of government spending on the level of labor productivity has been translated into a slowdown in the rate of growth in real wages for workers. By the mid-1990s, the excess of federal government spending over the level at which it begins exerting a negative effect had resulted in real compensation per hour being more than ten percent below what it otherwise would have been.<sup>3</sup>

### **The future is now**

It is always tempting to look into the future, especially as we enter a new millennium. To be sure, this is a somewhat risky exercise when dealing with economic events. The record of intellectuals in forecasting future economic events is not an encouraging one. The world is littered with crystal-ball reading economists with their mouths full of ground glass. In this case, though, the future may well be now.

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<sup>3</sup>See Gallaway and Vedder, 1996, for details.

Events of very recent years may provide us with a very good picture of what lies ahead for us. Federal government spending stood at 22.6 percent of Gross Domestic Product in fiscal year 1992, more than five percentage points greater than the annual level beyond which spending becomes counterproductive. Since then, we have been able to roll back the magnitude of government spending, taking it down to 19.7 percent of GDP in fiscal 1998 and projected at 19.4 percent for fiscal 2000. In a sense, this provides us with a mini-experiment with regards to the impact of reducing government spending in a relative sense. The results? Using the simplest indicator of economic performance, the rate of growth in GDP, the following observations can be made:

- (1) GDP growth in the six years following 1986 (taking us through 1992) averages 2.2 percent a year.
- (2) In the six years following 1992, it averaged 3.2 percent a year, a full percentage point higher.

To be sure, these data may be distorted by the business cycle downturn of 1991-92, but, at least, they are reasonably consistent with the proposition that the key to productivity-enhancing technological progress, and its accompanying economic growth, is a reduction in the volume of government interference in resource allocation decisions. What will happen as we move into the early years of the twenty-first century will depend on whether the role of government is further constrained to increase its technology friendliness. If it is, the future prospects are bright. If it is not, we may see a reversion to the relatively slow rates of growth in productivity and real wages that have marked the bulk of the last quarter of the twentieth century.

## References

- Ballard, Charles L., John B. Shoven, and John Whalley. (1995). General equilibrium computations of the marginal-welfare costs of taxes in the United States. *American Economic Review*.
- Barro, Robert. (1997). *Determinants of Economic Growth: A Cross-Country Empirical Study*. Cambridge and London: MIT Press.
- Clark, John Bates. (1899). *The Distribution of Wealth*. New York: Macmillan.
- Feldstein, Martin. (1995). Tax avoidance and the deadweight loss of the income tax. *National Bureau of Economic Research Working Paper*, 5055 March.
- Feldstein, Martin. (1995). The missing piece in social security reform. *National Bureau of Economic Research Working Paper*, 5413, January.
- Gallaway, Lowell, and Richard Vedder. (1995). *The Impact of the Welfare State on the American Economy*. Washington, DC: Joint Economic Committee of Congress.
- Gallaway, Lowell, and Richard Vedder. (1996). *The Impact of the Welfare State on American Workers*. Washington, DC: Joint Economic Committee of Congress.
- Gallaway, Lowell, and Richard Vedder. (1996). Labor laws: then and now. *Journal of Labor Research*, vol. 17, no. 2., Spring, 253-75.
- Gwartney, James, Robert Lawson, and Randall Holcombe. (1998). *The Size and Function of Government and Economic Growth*. Washington, DC: Joint Economic Committee of Congress..

Jevons, William Stanley. (1957). *The Theory of Political Economy*. New York: Kelley and Millman. Reprint of 1871 edition.

Marsden, Keith. Links between taxes and economic growth: some empirical evidence. *Journal of Economic Growth*, vol. 1, no. 4, 3-16.

Marshall, Alfred. (1920). *Principles of Economics*, 8th Edition. London: Macmillan.

Menger, Karl. (1952). *Principles of Economics*. Glencoe, IL: Free Press. Reprint of 1871 edition.

Rahn, Richard, and Harrison W. Fox, Jr. (1998). What is the optimum size of government? *Journal of Private Enterprise*, vol. 14, Special Edition, 1998, 72-85.

Rogers, James E. T. (1884). *Centuries of work and wages: the history of English labour*. New York: G. P. Putnam's Sons.

Scully, Gerald W. (1992). *Constitutional Environments and Economic Growth*. Princeton, NJ: Princeton University Press.

Scully, Gerald W. (1994). *What Is the Optimal Size of Government in the United States?* Dallas, TX: National Center for Policy Analysis.

Scully, Gerald W. (1998). The institutional framework and economic development. *Journal of Political Economy*, vol. 96, June, 652-62.

Vedder, Richard, and Lowell Gallaway. (1997). *Out of Work: Unemployment and Government in Twentieth Century America*. New York: New York University Press.

*Journal of Private Enterprise*

Vedder, Richard, and Lowell Gallaway. (1998a). The Laffer Curve, the Government, and economic growth. *Journal of Private Enterprise*, vol. 14, Special Issue, 63-71.

Vedder, Richard and Lowell Gallaway. (1998b). *Government Size and Economic Growth*. Washington, DC: Joint Economic Committee of Congress.



Take a trip through the past, present, and future of warehouse operations, and see how they are shaped and disrupted by successive waves of emerging technology. We'd love to learn what you think about the future of warehouse operations, and the roles technology will play in the warehouse or distribution centre of 2045. If you sometimes like to stretch your imagination a little and combine it with your professional warehouse knowledge, why not do so now and share your predictions in the comments section below? In theory, labor markets can benefit labor; in times of extreme need, the highest skilled workers can command higher salaries. Our reality is that automation is creating two starkly different versions of work. A problem that will continue to get worse under our present legal arrangements. Technology and the free labor society bring about an entirely new concept of work for the average American. The widespread ability to choose productive directions and access the resources necessary to make a genuine change will incite our experimental spirit. It will also force humanity to confront the new nature of work—more project-based, and less consistent. It is total certainty that the near future of technology will completely reshape labor. What form it takes is still to be determined. The labor markets in many countries are still not very flexible in that hours of work cannot be chosen by many employees. Not all workers are experiencing fewer working hours; for example, some highly educated workers are now working more hours. Advanced technology and increasing use of robots is likely to affect the supply of routine jobs and the demand for labor for many low- and semi-skilled workers. The compositional effects of female labor market participation and the prevalence of part-time work are important factors influencing total working hours. Taken together, these factors go some way toward explaining the overall variation in aggregate average working hours across countries. Labor markets are under strain, and talent is underutilized. Unemployment and underemployment are high around the world. In the United States and the 15 core European Union countries (EU-15), there are 285 million adults who are not in the labor force—and at least 100 million of them would like to work more. Some 30 to 45 percent of the working-age population around the world is underutilized—that is, unemployed, inactive, or underemployed. Technological change has reshaped the workplace continually over the past two centuries since the Industrial Revolution, but the speed with which automation technologies are developing today, and the scale at which they could disrupt the world of work, are largely without precedent. Video. From science fiction to business fact.